REMARKS

This Amendment is fully responsive to the Office Action mailed December 23, 2008. It is respectfully submitted that the claims contain limitations that patentably define over the references cited by the Examiner, for the reasons discussed in these remarks. Therefore, reconsideration and allowance of the pending claims is appropriate and respectfully requested.

Amendments to Specification

Two amendments to the specification are requested above to correct typographical errors. No new matter is entered by these amendments. In particular, replacing "B2" with "A2" is supported by the filed application at least in the context of the paragraph being amended, and at page 5, lines 11 to 19, and in Figure 1.

Claims 1 and 9

The Office Action rejected independent claims 1 and 9 each under 35 U.S.C. § 102(b) as being anticipated by US 2003/0146913 to Shen et al. (hereafter "Shen"). However, it is requested that this rejection be withdrawn because Shen does not disclose registration of image areas associated with preselected object constituents, as recited in both claim 1 and claim 9.

This exemplary feature of the invention is described, for example, in the present application at page 2, lines 16 to 20 (emphasis added):

> The registration of only those image areas of the two images which are associated with selected corresponding object constituents, the selected object components having to be relevant to the task in hand. As a rule, the user of the data processing unit determines in advance which object constituents are "relevant" in a given situation. In the trend control of lung tumors, for instance, the lungs are the relevant object constituents.

This determination in advance or "preselection" of the object constituents to be registered is not disclosed in Shen.

Shen describes a two step method for registering two lung images. In the first step (see Shen ¶¶ 0024 to 0029, and Figure 2), a calibration procedure is used to perform a "rough alignment" representing a linear transformation between the two lung images. The rough alignment linear transformation parameters are "based on the areas and boundaries of the two

lungs." See Shen, ¶ 0026. "In order to get the area and boundary information, the two lungs are segmented 110 from the image sets for each slice, mainly by techniques related to thresholds. Afterwards, the boundaries are obtained by boundary tracing 120." See id. "The alignment parameters are rough estimations of the transformations between the two image sets . . . ." See Shen, ¶ 0029. Thus the result of this first step is a rough pre-registration of the two image sets.

In the second step of Shen (see Shen ¶¶ 0030 to 0041, and Figure 3), a user interactively indicates a relevant reference point on a first image, such as a nodulus in the lung. See Shen, ¶ 0030. For example, according to Shen, "the system of the invention provides a graphical user interface (GUI) 30 that allows the user to browse through the volume data and select a volume-of-interest from one data set that includes an object of interest, such as a nodule 60." See Shen, ¶ 0023 (emphasis added). A volume-of-interest or VOI is defined around the click point in the first image. See Shen, ¶ 0030. Using the rough pre-registration linear transformation resulting from the first step, the location on the second image which corresponds to the indicated reference point is then calculated. See id. Next, searching in the proximity of the corresponding location in the second image as defined by a search window, a set of corresponding VOI's in the second image is identified. See id. The VOI from that set which is most similar to the VOI of the first image is identified by using a matching procedure, such as grayscale cross-correlation, sum of absolute differences, thresholding followed by summation of inclusive OR, or surface matching. See Shen, ¶¶ 0030 to 0041.

Neither of the two steps in the Shen registration method is a registration of "image areas associated with preselected object constituents" as recited in claims 1 and 9. The first "rough alignment" step of Shen is not a registration at all. Rather, it is merely a rough pre-registration alignment. This is established, for example, by the need in the second step of using a complicated matching procedure to match the VOI's. If the "rough alignment" results of the first step of Shen were a true registration, then there would be no need for such matching procedures in the second step. Rather, Shen could just use the "rough alignment" of the first step to determine the location of the corresponding VOI in the second image, if it were indeed a true registration. But it clearly is not.

The second step of Shen is not a registration of "preselected object constituents." Rather, in the second step of Shen, the user must identify a volume-of-interest such as a nodule in the first image, which is then registered in the two images. The nodule being registered is therefore not preselected.

For at least these reasons, Shen does not disclose registration of "image areas with preselected object constituents" as recited in claim 1 or claim 9. Therefore, Shen does not disclose each and every limitation of these claims, and the rejection of these claims as being anticipated by Shen should be reconsidered and withdrawn.

Claim 10

The Office Action rejected independent claim 10 under 35 U.S.C. § 102(b) as being anticipated by US 2003/0072479 to Sofia Totterman et al. (hereafter "Sofia Totterman"). However, it is requested that this rejection be withdrawn because Sofia Totterman does not disclose registration of image areas "using individually assigned registration methods" as recited in claim 10.

The Office Action relies on ¶ 0069 of Sofia Totterman as disclosing this claim limitation. The entire paragraph 0069 of Sofia Totterman is reproduced here, with the particular sentence believed to be relied upon in the Office Action emphasized:

> [0069] To take into consideration the movement of the many structures present in the region of interest, the approach of the present invention takes into account the local deformations of soft tissues by using a priori knowledge of the material properties of the different structures found in the image segmentation. Such knowledge is input in an appropriate database form at step 303. Also, different strategies can be applied to the motion of the rigid structures and to that of the soft tissues. Once the selected points have been registered, the motion vector of every voxel in the image is computed by interpolating the motion vectors of the selected points. Once the motion vector of each voxel has been estimated, the segmentation of the next image in the sequence is just the propagation of the segmentation of the former image. That technique is repeated until every image in the sequence has been analyzed. The definition of time and the order of a sequence can be reversed for convenience in the analysis.

See Sofia Totterman, ¶ 0069 (emphasis added). The Office Action pertinently concludes: "Also, different strategies (registration methods) can be applied to the motion of the rigid structures and to that of the soft tissues to register the image areas." Apparently, the reference to "different strategies" in the emphasized portion of Sofia Totterman was taken to refer to registration methods. That is not, however, what the sentence in Sofia Totterman says. The sentence in Sofia Totterman says that the "different strategies" are applied to motion, not to registration. Indeed, the very next sentence in paragraph 0069 establishes that motion and registration are different concepts, in that it states motion vectors are computed after the selected points are registered. Likewise, the opening sentence of paragraph 0069 begins, "To take into consideration the movement . . ." (emphasis added).

The following paragraph in Sofia Totterman — paragraph 0070 — discusses how to compute the motion vectors. It indicates the motion estimation approach of Sofia Totterman is an FEM-based point correspondence recovery algorithm between two consecutive images in a timed sequence. It "recovers the point correspondences by minimizing the total energy of a mesh of masses and springs that models the physical properties of the anatomy." See Sofia Totterman, at ¶ 0070 (emphasis added). Further, "the spring stiffness [in the FEM model] is computed from the first segmented image and a priori knowledge of the human anatomy and typical biomechanical properties for the tissues in the region of interest." See id. (emphasis added). For example, the spring constant in a bone region may be a relatively rigid elastic constant, while the spring constant in a soft tissue region may be a relatively soft elastic constant. See id. ¶ 0081. Thus, when read in the overall context of the entire paragraph 0069 and the following paragraph 0070, the reference in Sofia Totterman to applying "different strategies" "to the motion of the rigid structures and to that of the soft tissues" applies to calculating motion vectors, not to registration. The Sofia Totterman FEM-based point correspondence motion vector calculation is not a registration.

Moreover, even if the Sofia Totterman FEM-based point correspondence motion vector calculation is considered to be a "registration", still it is not a registration of image areas "using individually assigned registration methods" as recited in claim 10. Rather, Sofia Totterman discloses one and only one motion vector calculation method, that of modeling the image as a mesh of masses and springs. It is true that according to the Sofia Totterman model, different

areas of the image are assigned different mass values and different spring values to account for differing physical properties — such as might be expected between bone and soft tissue. However, still the same motion vector calculation is applied to each image area, that of a mesh of mass and springs. Thus Sofia Totterman does not disclose a registration of image areas "using individually assigned registration methods." It rather discloses one motion vector calculation which uses different values in different areas.

That is in contrast to the specification of the present application, which discloses different individually assigned registration methods such as for example an affine transformation and a rigid transformation. See page 2, line 31 to page 3, line 2, and page 6, lines 15-22.

For at least these reasons, Sofia Totterman does not disclose registration of image areas "using individually assigned registration methods" as recited in claim 10. Therefore, Sofia Totterman does not disclose each and every limitation of claim 10, and the rejection of claim 10 as being anticipated by Sofia Totterman should be reconsidered and withdrawn.

Claims 2 Through 8

The remaining claims, claims 2 through 8, each depend from claim 1. The Office Action rejected each of these dependent claims under 35 U.S.C. § 103(a) as being unpatentable over Shen (discussed above in connection with claim 1) in view of one other companion reference. In each rejection, Shen was relied upon as teaching the limitations of claim 1, and the companion reference was cited as teaching the limitations of one or more dependent claim. For at least the reason identified above, however, Shen does not disclose registration of image areas associated with preselected object constituents, as recited in claim 1. On that same basis, it is respectfully submitted that the corresponding obviousness rejections of the dependent claims should be reconsidered and withdrawn.

Particularly concerning dependent claim 2, it recites registering the image areas of various object constituents using individually assigned registration methods. The companion reference relied upon in the Office Action as disclosing that claim limitation is Sofia Totterman. For the reasons provided above concerning a corresponding limitation in claim 10, however, it is respectfully submitted that Sofia Totterman does not disclose that limitation. Therefore, on that

additional basis, it is respectfully submitted that the obviousness rejection of dependent claim 2 should be reconsidered and withdrawn.

Conclusion

This Amendment is fully responsive to the Office Action mailed December 23, 2008. It is respectfully submitted that the claims contain limitations that patentably define over the references cited by the Examiner, for the reasons provided in the remarks above. Therefore, reconsideration and allowance of the pending claims is appropriate and respectfully requested.

Respectfully submitted,

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